BDS

Berrenda Mesa Water District
14823 Hwy 33 • Lost Hills, CA 93249-9734

Lost Hills WATER DISTRICT

DUDLEY RIDGE WATER DISTRICT

January 29, 2013

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FEB - 4 2013
RWQCB-CVR
FRESNO, CALIF.

Ms. Bethany Soto
Regional Water Quality Control
Board, Central Valley Region
1685 E Street
Fresno, CA 93706-2007

Subject: Triennial Review for the Water Quality Control Plan Tulare Lake Basin

Dear Ms. Soto:

The California Regional Water Quality Control Board – Central Valley Region (the "Regional Board") is currently in the process of adopting a long-term Irrigated Lands Regulatory Program (the "Program") for central California's Tulare Lake Basin.

In support of that effort, AMEC Environment and Infrastructure ("AMEC") presented the *Westside Water Districts' Preliminary Water Quality Report* to the Regional Board at the November 30, 2012, Workshop held in Bakersfield. AMEC presented the report on behalf of Belridge Water Storage District, Berrenda Mesa Water District, Dudley Ridge Water District, and Lost Hills Water District (collectively the "Districts") and the report was entered into the record for the draft Southern San Joaquin Valley General Order for Discharges to Irrigated Lands. Based on the poor quality of groundwater in the area, the Districts requested that the Regional Board use its discretion under the *Sources of Drinking Water Policy* and other Tulare Basin Plan policies to exempt farmers within the Districts from groundwater regulation under the Program.

In addition to the November 30, 2012, presentation, representatives of the Districts met with Regional Board staff on December 18, 2012, to discuss how to accomplish the request. The Districts' representatives offered to assist the Regional Board staff in assembling and analyzing available groundwater data to support the designation of appropriate beneficial uses of groundwater.

The Regional Board staff followed up with a December 19, 2012 e-mail describing the general process and suggested a minimum scope of work to support a basin plan amendment. The Districts sincerely appreciate the effort put into the follow-up email. The email described a basin plan amendment process that involved 2½ years of effort, including "review and approval by CV-Salts Technical Committee." Once the CV-Salts Technical approves the proposed amendment, the "Regional Board holds an adoption meeting to consider the amendment" and "the amendment must go through an approval process before the State Water Board and the Office of Administrative Law."

Pursuant to the *Sources of Drinking Water Policy*, beneficial use designations are required to be approved by the Regional Board, the State Water Board and the Office of Administrative Law. That would seem to be a more than sufficient review and approval process for consideration of the Districts' request. However, the Regional Board staff seem insistent on inserting yet another review, consideration and approval process by a fourth party (CV-Salts) before the Regional Board will even consider the Districts' request.

CV-Salts (Central Valley Salinity Coalition) "is (a) non-profit and formed in July 2008 to organize, facilitate and fund efforts needed for the efficient management of salinity in the Central Valley." The Districts question the necessity for involving CV-Salts in their November 30, 2012 request of the Regional Board. Considering the 2½ year approval process involved in a typical basin plan amendment, the front-loading of CV-Salts review and approval can only extend the duration and cost of ultimate approval by the Regional Board, State Water Board and the Office of Administrative Law. It is not clear to the Districts that CV-Salts has any jurisdiction in the determination of beneficial uses of groundwater within the Districts. Without some evidence of legitimate jurisdiction by CV-Salts, the Districts see very little value in pursuing approval by CV-Salts Technical Committee.

The Districts would like to pursue their November 30, 2012 request through the Regional Board's Triennial Review process for the *Water Quality Control Plan for the Tulare Lake Basin Plan,* without involving review and approval by the CV-Salts Technical Committee. The Districts hereby submit this request for inclusion of reevaluation of beneficial uses of groundwater within the Districts in the Regional Board's 2013 Triennial Review process. To support that request, attached is a copy of the Districts' original request of the Regional Board, presented at the Board's November 30, 2012 public workshop meeting. As previously indicated to the Regional Board, the Districts' representatives have offered to assist the Regional Board staff in assembling and analyzing available groundwater data to support the designation of appropriate beneficial uses of groundwater beneath the Districts.

In addition to the above, the Districts request a timeline with milestones for the Triennial Review process of the proposed basin plan amendment.

If you have questions concerning this request, please call me.

Sincerely yours,

Greg A. Hammett
General Manager
Belridge Water Storage District

1-29-13
Date

Attachment A: Westside Water Districts' Preliminary Water Quality Report

ccs:
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WESTSIDE WATER DISTRICTS' PRELIMINARY WATER QUALITY REPORT

Prepared by Timothy G. Souther and Gary L. Kramer of
AMEC Environment & Infrastructure, Inc. and
Reviewed by Greg A. Hammett of
Belridge Water Storage District
for

Belridge Water Storage District,
Berrenda Mesa Water District,
Dudley Ridge Water District, and
Lost Hills Water District

Abstract: *Four California water districts (Belridge Water Storage District, Berrenda Mesa Water District, Dudley Ridge Water District, and Lost Hills Water District) are located along the southwestern border of the Tulare Lake Basin in western Kern and Kings Counties of California. The Districts have requested that AMEC Environment & Infrastructure, Inc. (AMEC) prepare a summary of groundwater information within the Districts to address the Irrigated Lands Regulatory Program of California Regional Water Quality Control Board, Central Valley Region (RWQCB). The most recent version of the program includes regulation of discharges to groundwater from irrigated lands. This report summarizes groundwater information for the Districts' areas from reports published by federal, state and local agencies. These published reports demonstrate that groundwater below the Districts is of sufficiently poor mineral quality that it is unsuitable for municipal water supply and is only rarely used for agricultural water supply after substantial blending with imported, high quality, surface water supplies. These poor quality groundwater conditions are consistent with several of the exceptions described in the "Sources of Drinking Water" policy (Resolution 88-63) originally adopted by the State Water Resources Control Board (1988) and subsequently by the Regional Water Quality Control Board. Based on the poor quality of groundwater in the area, the Districts ask the RWQCB to use its discretion under the "Sources of Drinking Water Policy" and other Tulare Lake Basin Plan policies to exempt farmers within the Districts from groundwater regulation under the Irrigated Lands Regulatory Program.*

The California Regional Water Quality Control Board – Central Valley Region (RWQCB) is embarking on the long-term Irrigated Lands Regulatory Program (ILRP) for the Tulare Lake Basin (Basin) in central California. The most recent versions of the ILRP (RWQCB, 2012) propose to regulate discharges to groundwater from irrigated agriculture. Four water districts along the western edge of the Basin (Belridge Water Storage District, Berrenda Mesa Water District, Dudley Ridge Water District, and Lost Hills Water District, collectively identified as the Districts and shown on Figure 1) have retained AMEC Environment & Infrastructure, Inc. (AMEC), to prepare a summary report describing groundwater resources within the Districts to assist the RWQCB in considering how to implement the ILRP along the western edge of the Basin. This white paper is the first installment of AMEC's work on behalf of the Districts and includes a summary of area geology, climate, surface waters, and groundwater on a regional scale based on review of published regional reports.

In the California Water Plan, the Department of Water Resources (DWR, 2009) found: "In the western (San Joaquin) valley area, groundwater quality is often poor, and availability is highly variable. In addition, drainage problem areas have developed with high water tables with high total dissolved solids." Groundwater below the Districts is naturally of poor mineral quality, primarily due to contact with marine sediments derived from the Temblor Range that borders the San Joaquin Valley on the west. Those marine sediments and their associated salts have been transported by alluvial processes into the valley. Groundwater in the Districts occurs in perched, unconfined, semi-confined, and confined aquifers. Groundwater quality in each of these zones typically exceeds 2,000 milligrams per liter (mg/L) of total dissolved solids (TDS) and contains other inorganic chemicals (arsenic) that prevent use of groundwater as a potable water supply. For municipal water supply, water is imported into the Districts and treated as necessary. Groundwater use for agricultural irrigation is limited by high TDS and boron concentrations. As such, groundwater irrigation has been almost completely replaced by imported surface water irrigation from the State Water Project (SWP) (California Aqueduct).

THE DISTRICTS

The Belridge Water Storage District (BWSD) encompasses 92,000 acres of land in western Kern County (Figure 1). BWSD slopes from the Antelope Hills and Belridge Oil Field on the west to the California Aqueduct in the valley floor on the east. The BWSD has a contract for 121,508 acre-feet per year of irrigation water from the SWP to about 52,000 acres of developed agricultural land between Highway 33 on the west and the Kern River Floodway on the east and California Highway 46 and the community of Lost Hills on the north (BWSD, 2012). This allocation of SWP water amounts to about 2.3 acre-feet per acre annually. No established communities are present within the BWSD. Oil field operations are present along the west side of California Highway 46 and immediately south of Lost Hills. A food processing plant along Highway 46 is also within the BWSD.

Groundwater beneath the BWSD is of poor mineral quality and is not used for potable water supply, but is occasionally blended with SWP surface water and used for irrigation. Oil field operations in the Belridge Oil Field extract oil and produced water (brine) that is re-injected into exempted aquifers for disposal or use in water or steam flood enhanced petroleum recovery operations in accordance with regulations of the California Division of Oil, Gas, and Geothermal Resources (DOGGR). BWSD participates in several water banking projects, located immediately adjacent to the Kern River, to develop water supplies for use in dry years.

Berrenda Mesa Water District (BMWD) encompasses 55,440 acres of land in the upper Antelope Plain (Figure 1). BMWD extends north and west of BWSD and is bordered by California Highway 46 on the south, the Coastal Aqueduct along the north, and Lost Hills Oil Field on the west. BMWD has a contract for 92,600 acre-feet per year of irrigation water from the SWP to 49,000 acres of developed agricultural land. This SWP allocation amounts to about 1.9 acre-feet per acre annually. BMWD includes the small community of Blackwell's Corner at the intersection of Highway 46 and Highway 33 and extends southeast almost to the community of Lost Hills. BMWD also includes a food processing plant along Highway 46. Groundwater from the BMWD is of poor mineral quality and is not used for potable water supply. Groundwater is imported from the Lost Hills Utility District (LHUD) for potable supply in Blackwell's Corner; LHUD imports water from 13 miles further east and beyond the borders of any of the Districts. BMWD participates in water banking projects, located immediately adjacent the Kern River, to develop water supplies that can be available during dry years.

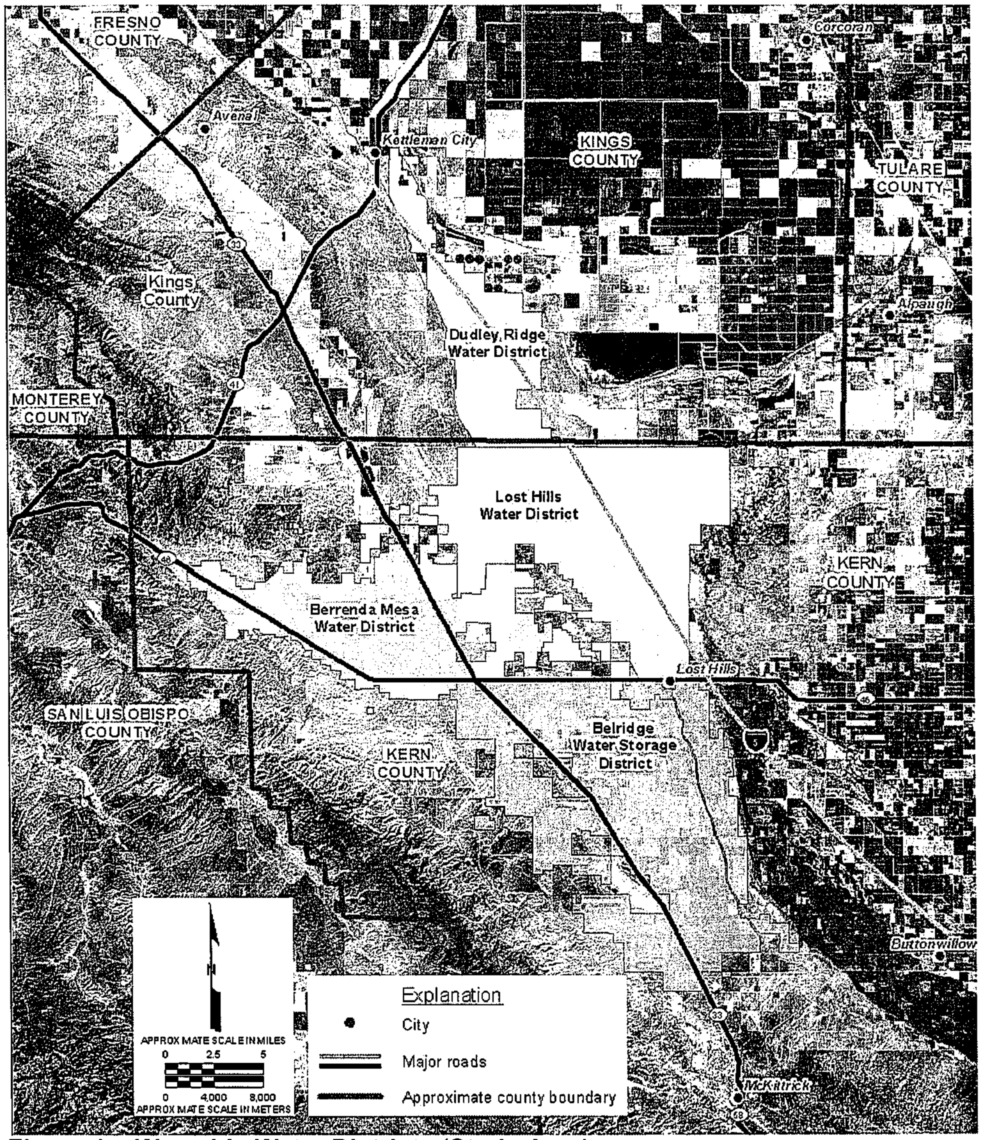


Figure 1 – Westside Water Districts (Study Area)

Dudley Ridge Water District (DRWD) encompasses 37,600 acres of land extending north of the border of Kings and Kern counties on the south, the California Aqueduct on the west, Tulare Lake Bed on the east, and a narrow strip of land on either side of Interstate Highway 5 north to (but not including) Kettleman City (Figure 1). DRWD has a contract for 50,343 acre-feet per year of SWP water that is currently used on 17,000 acres of developed agricultural land. This allocation of SWP water amounts to about 2.9 acre-feet per acre annually. DRWD does not include established communities, although its northern border abuts the community of Kettleman City. Groundwater from the DRWD is of poor mineral quality and is not used for drinking water; DRWD indicates that one well (Section 17, 23S/20E) is used for toilets and sinks (bottled water used for drinking). DRWD participates in the water banking projects, located immediately adjacent to the Kern River, to develop water supplies that can be available during dry years.

Lost Hills Water District (LHWD) encompasses 72,183 acres of land and extends east of BMWD to the Kern National Wildlife Refuge (Refuge), south to the community of Lost Hills, and north to the border of Kings and Kern counties (Figure 1). LHWD supplies 119,110 acre-feet per year of SWP water to about 56,000 acres of developed agricultural land (LHWD, 2012). This allocation of SWP water amounts to about 2.2 acre-feet per acre annually. LHWD abuts the community of Lost Hills to the south and includes a food processing plant along King Road. Devils Den Oil Field borders LHWD along the northwest and Lost Hills Oil Field borders along the south of LHWD. Oil field operators extract oil and re-inject associated brine into exempted aquifers for disposal or use in water or steam flood enhanced petroleum recovery operations. Groundwater from the LHWD is of poor mineral quality and is not used for potable water supply. Groundwater is imported from 13 miles east of LHWD for potable supply in the community of Lost Hills (KIRWMP, 2011). In water short years, LHWD purchases supplemental water.

Prior to delivery of SWP water to the Districts, the DWR prepared evaluations of the feasibility of providing water from the California Aqueduct to the Districts (DWR, 1963 and 1964). DWR's evaluation of existing surface and groundwater conditions in the Districts are provided in the following paragraphs.

<u>Belridge Water Storage District, Antelope Plain and Lost Hills Water Districts</u>
(Antelope Plain Water District is now the Berrenda Mesa Water District)

"There is no usable surface water supply in these three districts except for sporadic flood flows. These districts are relatively undeveloped and have generally similar ground water conditions. There are no commercially irrigated lands in the Belridge Water Storage District. A few thousand acres are irrigated by ground water in the Antelope Plain Water District, and about 10,000 acres are irrigated in the Lost Hills Water District from groundwater and occasional surface water from the Kern River.

The yields of existing wells are for the most part low, and the quality of groundwater is poor. Crops produced on these lands are limited to those which are tolerant to poor quality water. Any significant additional development of these districts is dependent upon an imported water supply.

Ordinarily, in an area having ground water, there is the opportunity to make efficient use of imported water supplies by re-using that portion of the water which percolates beyond the crop root zone to the underlying ground water basin. In these districts, however, the material under-lying the surface is very dry, and it is believed that virtually all percolating water would be absorbed for several decades.

In these districts the existing poor quality of ground water provides an additional problem. Even the percolation of additional water will not improve these waters to the point where they could be used without mixing with surface supplies. It seems highly doubtful, however, that this would have any appreciable effect prior to 1990."

<u>Dudley Ridge Water District</u>

"For all practical purposes, there is no local surface water supply available to the District. Only occasionally during storms do the normally dry arroyos of the Kettleman hills have sufficient runoff to reach the District.

At present, the principal water supply for irrigation of land in the District is conveyed some 40 miles from sources to the east located outside the District.

There are some producing wells in the extreme northern part of the District that supply a small portion of the present water supply. Most wells that have been drilled, however, have been abandoned due to poor yield and poor quality of groundwater. Studies made for this report indicate that it would be physically possible to recapture percolate from future imported supply, but the poor quality of water underlying the area would make it unsuitable for reuse, at least for a significant number of years. It is planned that this supply will be used outside the District after water is received from the California Aqueduct."

CLIMATE

Climate in the Districts is characterized as an inland Mediterranean climate with hot and dry summers and cool winters. The average annual precipitation at the Blackwell's Corner and Kettleman City stations is 4.5 and 6.6 inches, respectively (WRCC, 2012). The average annual reference evapotranspiration for DRWD is 58 inches and for BWSD, BMWD, and LHWD is 62 inches (CIMIS, 2009). These climatic conditions resulted in desiccation of soils before irrigation development within the Districts that restricts deep percolation of irrigation water.

SURFACE WATER

All of the Districts are within the South Valley Floor Hydrologic Unit (specifically HA 558.60 and HA 557.30) (RWQCB, 2004). Ephemeral stream beds occur in the upper reaches of the HAs and drain to the east (BWSD, BMWD, DRWD, and LHWD) into the Districts. Runoff in these streams is not controlled and typically percolates prior to reaching the valley floor. The 100-year, 24-hour storm for this area ranges from 3 to 3.5 inches (NOAA, 2012).

Irrigation canals and drainage facilities are the main surface water features within the Districts. Besides these features, the dominant surface water features in the area of BWSD, BMWD, DRWD, and LHWD are the California Aqueduct, its Coastal Aqueduct, and the Refuge. Other surface water features in the area include the Tulare Lake Bed, Goose Lake, and Kern/Buena Vista Lake.

The designated beneficial uses of surface water in South Valley Floor Hydrologic Unit are agricultural supply (AGR); industrial supply (IND); process water supply (PRO); non-contact water recreation (REC-2); warm freshwater habitat (WARM); wildlife habitat (WILD); rare, threatened, or endangered species (RARE); and groundwater recharge (GWR) (RWQCB, 2004). The uplands (above the Districts) consist of 11 relatively small watersheds of 9 to 104 square miles (Figure 2) that produce little runoff ranging from 100 to 2,700 acre-feet per year (USGS, 1983).

Wetlands occur within the Refuge and the Goose Lake wetlands. The 11,249-acre-Refuge is located just west of the LHWD and includes approximately 5,000 to 6,500 acres of seasonal wetlands, irrigated moist soil units, and riparian habitat. Upland areas of the Refuge total about 3,600 acres of grassland, alkali playa, and valley sink scrub habitats. Water supply for the Refuge is provided by the California Aqueduct. The Water Management Plan for the Refuge (USBR, 2011) indicates:

"Groundwater has elevated levels of boron, arsenic and sodium. The depth to ground water makes the pumping very expensive. All wells are inactive with deteriorated casings and only four of the wells have pumps. These wells would only be used in a short-term emergency and only if money were available to pay the pumping costs."

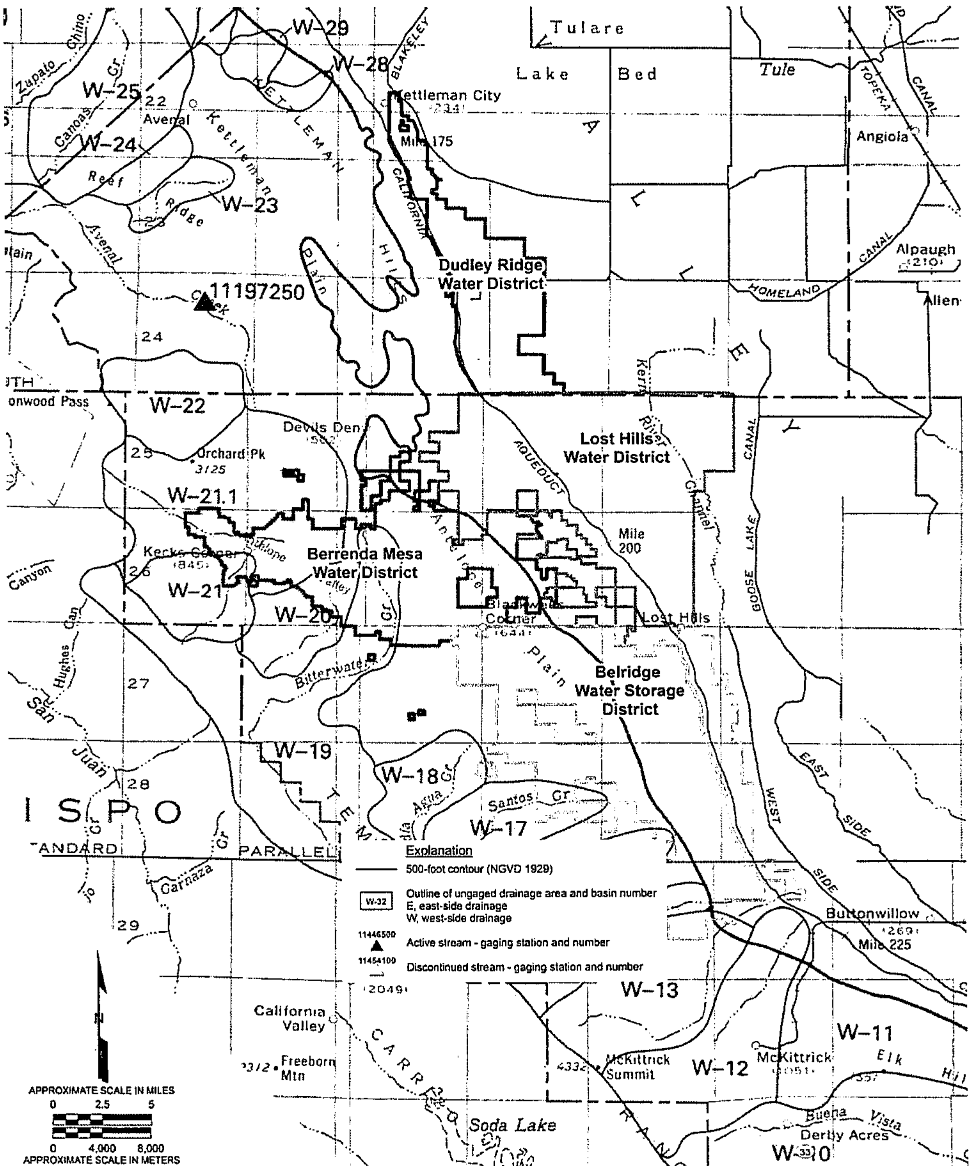


Figure 2 – Watersheds in Western Kern/Kings Counties (modified from USGS 1983)

Goose Lake is a privately held, ephemeral wetland that is habitat for threatened or endangered species. Goose Lake is located between Wasco and Lost Hills in western Kern County, but not within any of the Districts. The United States Bureau of Reclamation (USBR) is attempting to organize a management plan at Goose Lake for species protection. The USBR indicates that the wetland contains native alkali grassland and native alkali scrub habitat. Goose Lake is reportedly maintained by surface waters from a variety of sources (USBR, 2012).

SURFACE WATER QUALITY

Other than water in the California Aqueduct, very little surface water monitoring data have been collected recently within the Districts. California Aqueduct water delivered to the Districts averages 440 mg/L TDS (KIRWMP, 2011). The electrical conductance (EC) of water in the California Aqueduct at Kettleman City (Station C21) has ranged from 130 to 813 µmhos/cm and averaged about 500 µmhos/cm over the past five years (DWR, 2012). This range of ECs is roughly equivalent to a TDS range of 100 to 570 mg/L.

No Total Maximum Daily Load has been established for surface waters within the Districts (SWRCB, 2012c). The Southern San Joaquin Valley Water Quality Coalition has been monitoring a surface water station at the Main Drain Canal at Highway 46 (558MDCH46) since 2004. The TDS concentrations in the Main Drain Canal water has ranged from 270 to 2,410 mg/L over the period from 2004 through 2008 (SWRCB, 2012a).

GEOLOGY

The Districts are in the southwestern portion of the San Joaquin Valley. Regional geology in the southwestern San Joaquin Valley is characterized by a long history of structural deformation associated with tectonic movement along the continental borderland, including the prominent and still active San Andreas Fault. Uplift of the Sierra Nevada east of the valley, later uplift of the Temblor Range on west side, and formation of the deep structural trough beneath the valley floor, have resulted in the accumulation of more than 20,000 feet of marine and terrestrial sediments of Cretaceous to Holocene age throughout the basin (Maher et al., 1975).

REGIONAL STRATIGRAPHY

The stratigraphy of the southwestern San Joaquin Valley comprises marine sedimentary rocks from the Jurassic/Cretaceous through Tertiary Periods and unconsolidated non-marine sediments from Late Tertiary and Quaternary Periods (Figure 3).

The oldest marine sediments are exposed in the Temblor Range from north of Highway 41 south to Highway 58. Younger marine formations are exposed to the east, approaching the valley floor. The stratigraphic relationships of these formations are complex, owing to the significant structural deformation present on the west side of the valley.

The continental Tulare Formation overlies various marine formations along the west side of the valley. In many areas, the Tulare Formation is overlain by younger alluvium. In areas where the Tulare Formation is absent, the younger alluvium directly overlies older marine sediments.

The Tulare Formation and overlying alluvium consist of coarse-grained facies east of the Temblor Range associated with alluvial fan deposition from the upland of the Temblor Range. West of the Kettleman and Lost Hills areas, these coarse-grained alluvial facies become interbedded with fine-grained facies associated with lacustrian, fluvial, deltaic, and marshland deposits from the pre-historic and historic Tulare Lake and Goose Lake, as well as the Kern River flood plain situated between them (Croft, 1972; Page, 1983). The Tulare Formation and overlying alluvial sediments comprise the major aquifers beneath the San Joaquin Valley. These are discussed in further detail below (see Hydrogeology).

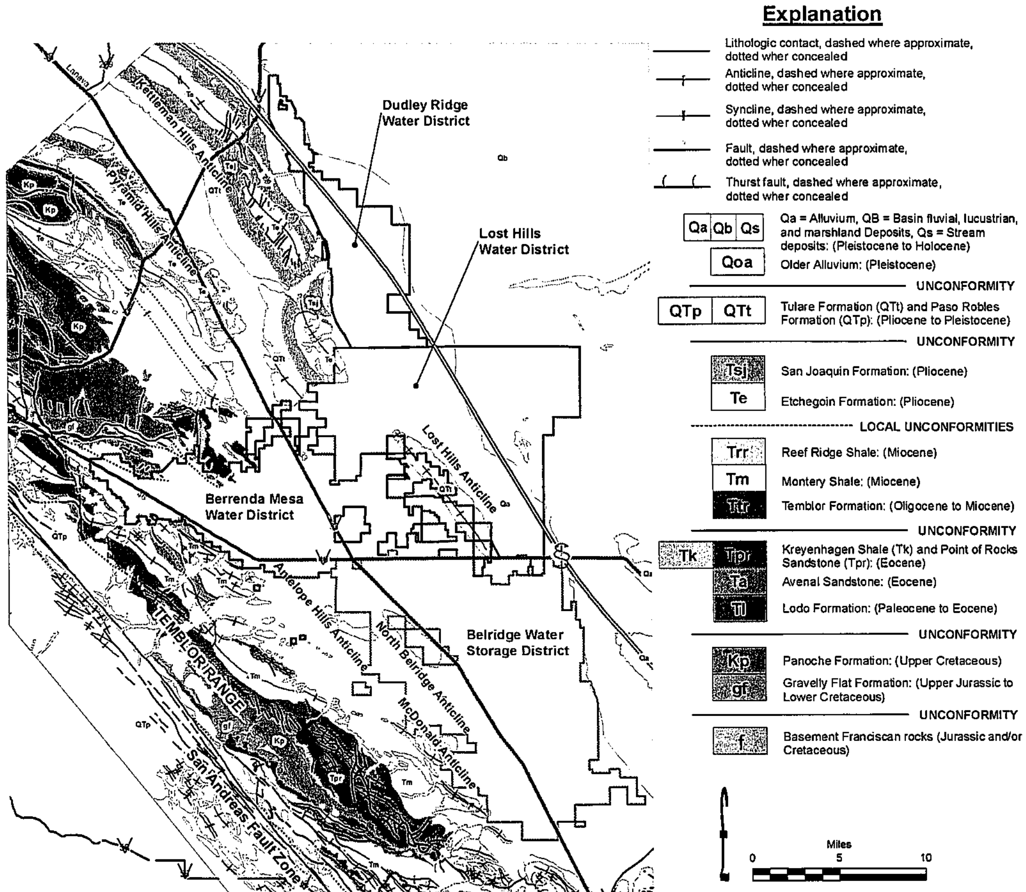


Figure 3 – Surface Geology of the Tulare Lake Basin (modified from Dibblee, 1973, Graham et al. 1999, Hilton et al. 1963, and Dale et al. 1966)

The following Figure 4 is a generalized geologic cross-section of the southern San Joaquin Valley.

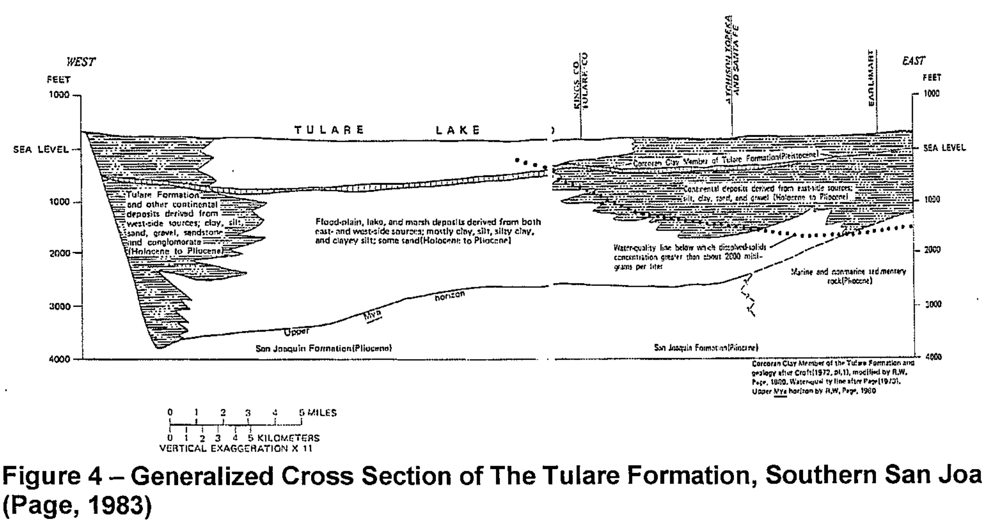


Figure 4 – Generalized Cross Section of The Tulare Formation, Southern San Joaquin Valley (Page, 1983)

REGIONAL STRUCTURAL GEOLOGY

The topography and geology of the southwestern San Joaquin Valley has been shaped by the regional tectonic environment and subsequent erosion. The dominant structure in the region is the San Andreas Fault. The regional stress field developed by slip along the irregular fault trace of the San Andreas has resulted in ancillary faulting within the Temblor Range paralleling the San Andreas. Furthermore, regional compressional forces along this margin have resulted in the uplift and formation of highly folded and faulted marine sediments in the Temblor Range and the development of a series of en-echelon anticlines and synclines east of the Temblor Range that either plunge to the southeast or are doubly-plunging toward the northwest and southeast.

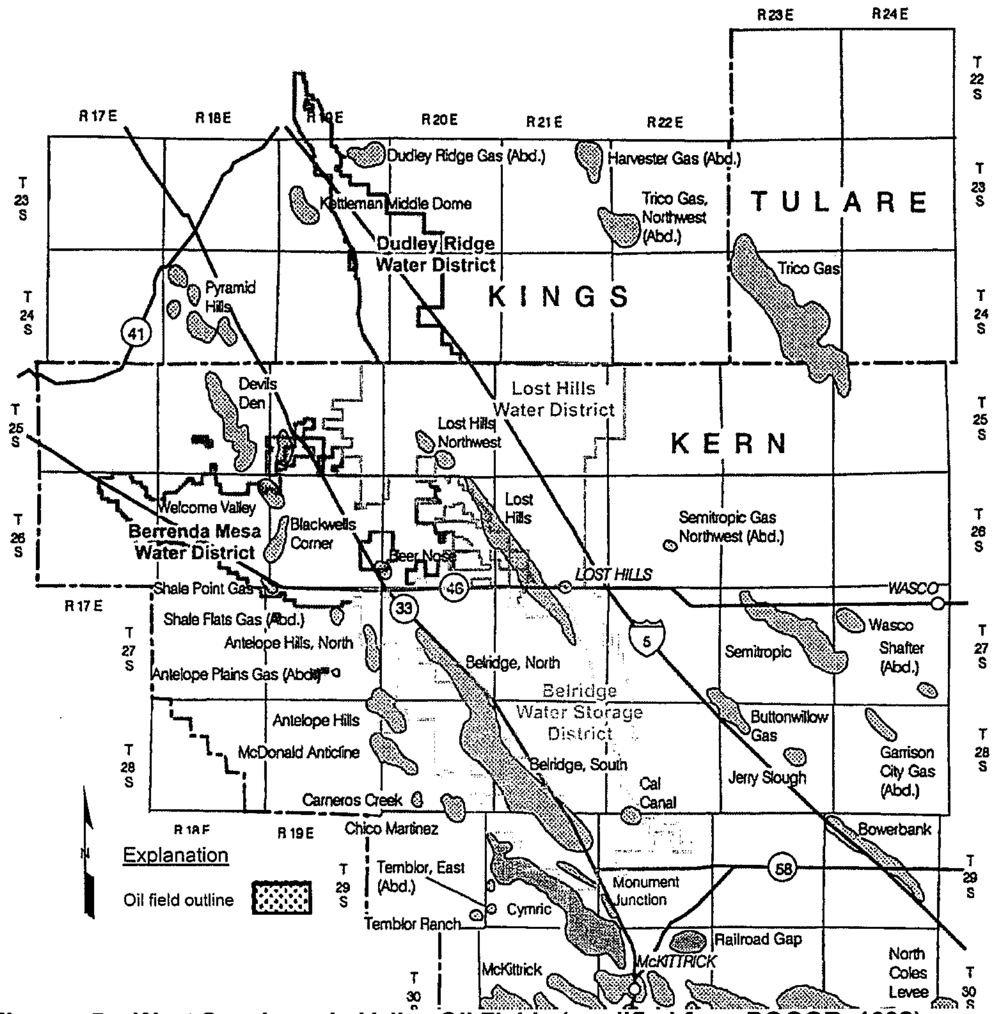
Several anticlines and synclines that have been exposed in the vicinity of the Districts include: (1) the Kettleman Hills anticline west of DRWD, northwest of LHWD, and northeast of BMWD; (2) Pyramid Hills anticline and syncline north of BMWD; (3) the Lost Hills anticline bisects portions of the southeastern portion of the LHWD and is east of BMWD and north of BWSD; (4) highly folded Monterey Shale of the Shale Hills lies adjacent to the western boundary of BMWD; (5) the North Antelope Hills anticline is situated west of the BWSD; (6) the North Belridge anticline is located within the BWSD; (7) the McDonald anticline is situated west of the BWSD; and (8) the northern extension of the Elk Hills anticline lies west of the southwestern portion of the BWSD (Dibblee, 1973; and Graham et al., 1999).

Post-Pliocene deposition of marine and terrestrial sediments occurred under the tectonic environment of the San Andreas Fault and associated developing anticline and synclines. Deposition associated with tectonic movement over time results in the incremental deformation of these sediments as the duration and magnitude of deformations progresses over time. This has implications on the occurrence and flow of groundwater in aquifers that have developed in the Tulare Formation, older alluvium, and alluvial sediments adjacent to the Temblor Range. These structures have also contributed to the localization of oil and gas resources in the region.

ECONOMIC GEOLOGY

Within the Tulare Lake Basin, mineral resources are mined to produce aggregates, precious metals, petroleum, and natural gas. For this summary, we are focusing on production of oil and gas within the Districts' areas.

Oil and gas recovery operations occur immediately adjacent to each of the Districts or historically within portions of the Districts. Designated oil fields include North Antelope Hills, Antelope Hills, McDonald Anticline, Carneros Creek, Chico Martinez, Cymric, Monument Junction, North Belridge and South Belridge Oil Fields east the BWSD; Deer Nose, Welcome Valley, Shale Point Gas, and Blackwells Corner Oil Fields adjacent BMWD; Lost Hills Oil Field between BMWD and LHWD and within portions of BWSD and LHWD; and Kettleman Middle Dome west of DRWD. Oil field operations extract various grades of petroleum, natural gas, and associated produced water (brine). The brine is re-injected into designated exempt aquifers for disposal or use in water or steam flood enhanced petroleum recovery operations in accordance with regulations of the DOGGR.



Figures 5 – West San Joaquin Valley Oil Fields (modified from DOGGR, 1998)

Formations that produce oil and gas generally do not produce usable groundwater as a drinking water source because of dissolved petroleum and salts in the water. For example, the reported TDS in brine produced in the North Belridge Oil Field ranges from 21,400 to 42,000 mg/L. Current production zones range from 1,000 to more than 15,000 feet in depth. However, some of the early oil and gas production was much shallower; the average depth of production from the shallow Tulare Formation wells in Lost Hills Oil Field and South Belridge Oil field were 200 and 400 feet in depth, respectively (DOGGR, 1998). The State Water Resources Control Board (SWRCB) authorized exempted aquifers for reinjection of brine water back into these oil producing zones (DOGGR, 1981). Until recently, the RWQCB regulated percolation pond discharges of produced oil/gas brine water in westside oil fields. These discharges have affected the quality of shallow groundwater below and downgradient within the Districts (RWQCB, 2006). The following example hydrogeologic section (Figure 6) for brine ponds in Belridge Oil Field is cited in RWQCB, 2006.

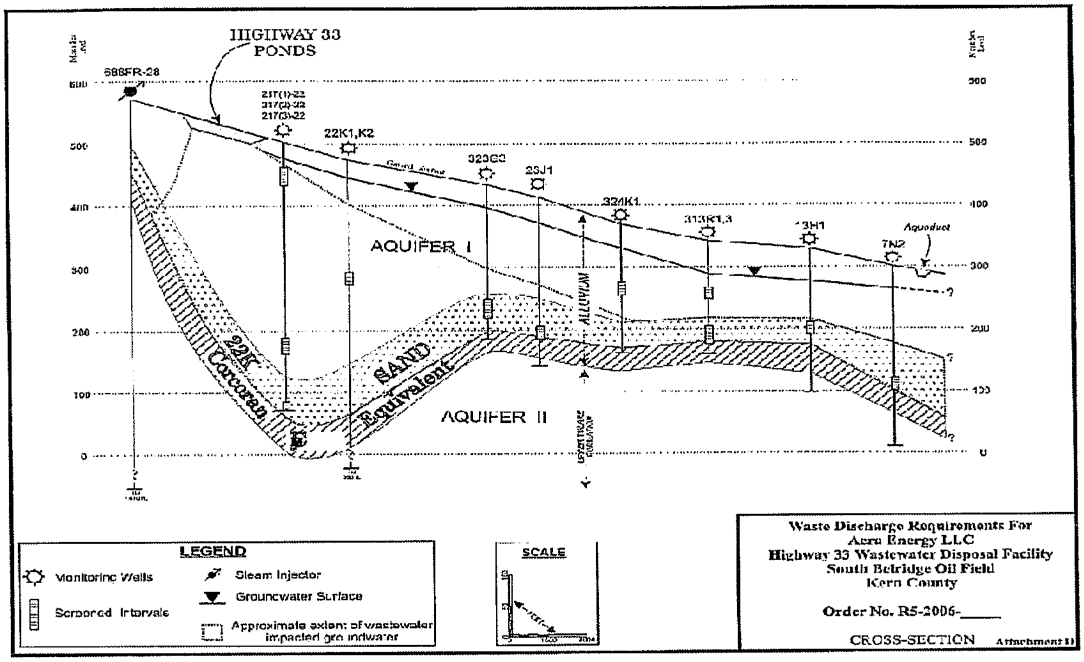


Figure 6 - West-East Geologic Cross-Section, South Belridge Oil Field (RWQCB, 2006)

This cross section shows that oil field brine ponds have affected groundwater downgradient within BWSD (between the Highway 33 ponds and the California Aqueduct). Only a few of the former oil field ponds have included such detailed groundwater monitoring. However, there is a potential that other historic or current oil field operations have resulted in similar downgradient groundwater effects within each of the Districts.

HYDROGEOLOGY

The Districts are all within Detailed Analysis Units (DAUs) designed by the Tulare Lake Basin Plan (RWQCB, 2005):

BWSD, BMWD, and LHWD in DAU 259
DRWD in DAU 246

The designated beneficial uses of groundwater in DAU 259 and DAU 246 are municipal supply (MUN), AGR, and IND (RWQCB, 2005). Groundwater in each of the Districts occurs as perched (unconfined), semi-confined, and confined groundwater.

AQUIFER SYSTEMS

Groundwater beneath the Districts occurs under perched, unconfined, and confined conditions. Areas of shallow perched groundwater within the Districts appear to correspond to the presence of a shallow clayey until (designated the A-clay) beneath the Districts. The perched aquifer consists of Pleistocene-Holocene fluvial and flood basin sediments comprised predominately of silts and clay interbedded with sand layers (Hilton et al., 1963; Croft, 1972). These sediments overlie the A-clay and grade laterally into younger alluvium to the west. The areal extent of perched aquifers appears centered on an axis along the Kern River Flood Channel between Goose Lake and Tulare Lake beds and lie east of the California Aqueduct (DWR, 2008). The lateral extents of the A-clay are poorly constrained. The A-clay reportedly has been encountered under LHWD at depths of 30 to 60 feet (PPEG, 2007).

Unconfined aquifers exist in alluvial sediments of Antelope Valley east of the Lost Hills Anticline and below the perched groundwater in the upper Tulare Formation. The unconfined aquifer consists predominately of coarser alluvial sediments flanking the Temblor Range that grade laterally eastward into finer grained fluvial, marsh, deltaic, and lucustrian deposits between Goose Lake and Tulare Lake. In areas where fluvial deposits become highly interbedded and bifurcated, semi-confined groundwater conditions may be encountered in the upper Tulare Formation. The base of the unconfined aquifer is defined by the presence of the E-clay where it is present. In areas where the E-clay is absent the unconfined aquifer extends to the top of the marine formations.

The modified E-clay described in Page (1986) forms the major regional aquitard that separates the upper unconfined aquifer from the lower confined aquifer in the southwestern San Joaquin Valley. In the Districts, it has been encountered in wells east of the California Aqueduct (Page, 1986). The E-clay is also known to underlie DRWD and portions of LHWD east of the Lost Hills Anticline, but appears absent west of this structure beneath the Antelope Plain (PPEG, 2007) and BMWD. The presence of the E-clay beneath BWSD west of the aqueduct is poorly constrained. The depth at which the E-clay is encountered varies due to the presence of anticline and syncline structures along the west side of the valley. It is encountered as shallow as 100 feet along the east limb of Lost Hills (PPEG, 2007) to as deep as 900 feet near the southwest edge of Tulare Lake bed (Page, 1986). The thickness of the E-clay ranges from 8 feet south of Lost Hills to 205 feet near the southwest edge of Tulare Lake bed (Page, 1986).

Groundwater below the E-clay is encountered in confined conditions. The Tulare Formation below the E-clay consists of unconsolidated interbedded sand, silt, and clay. The nature of these sediments ranges from coarser alluvial fan deposits near the Temblor Range to fine-grained lucustran, fluvial, and marsh deposits eastward toward the axis of the valley trough (Croft, 1972).

GROUNDWATER OCCURRENCE

The California Department of Water Resources (DWR) indicates that perched groundwater occurs below the Districts (DWR, 2011). Perched water in portions of the BWSD, LHWD, and DRWD ranges in depth from 5 to 20 feet (Figure 7). DWR does not identify perched groundwater in the BMWD, although it may be present in some areas.

The DWR does not characterize the occurrence of semi-confined or confined groundwater within the Districts due to lack of current data. However, the Kern County Water Agency (KCWA) indicates the depth to groundwater in the Districts (except BMWD and DRWD) in 2001 was between 50 and 100 feet with a general gradient to the east.

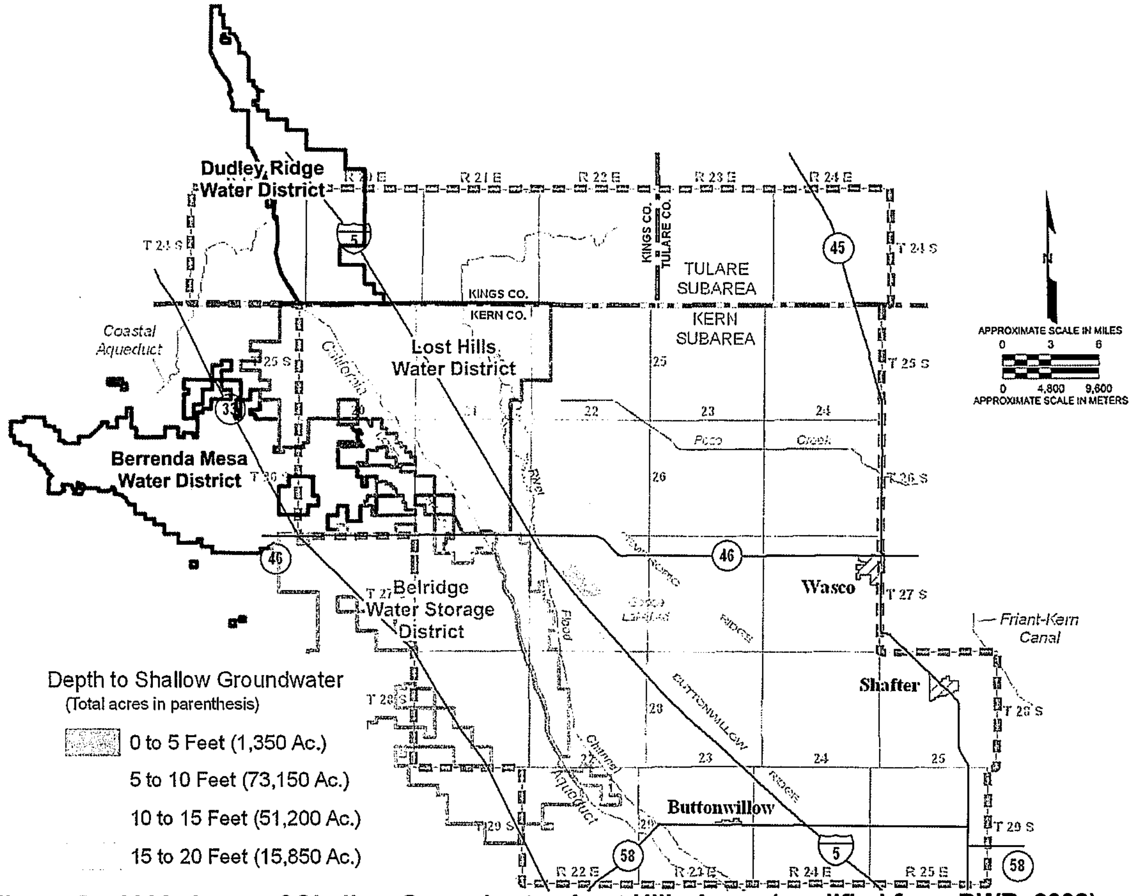


Figure 7 – 2008, Areas of Shallow Groundwater, Lost Hills Areas (modified from DWR, 2008)

GROUNDWATER QUALITY

AMEC reviewed groundwater quality data from several sources. These included the RWQCB, DWR, KCWA, United States Geological Survey (USGS), and private sector consultants and non-governmental coalitions. These materials are discussed in the following subsections.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

The designated beneficial uses of groundwater in DAU 259 and DAU 246 are MUN, AGR, and IND (Basin Plan; RWQCB, 2005). The Basin Plan indicates that "Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses." For salinity, the Basin Plan indicates that "All ground waters shall be maintained as close to natural concentrations of dissolved solids as is reasonable…the water quality objectives for groundwater salinity control the rate of increase." For the Westside Hydrographic Unit (includes DAU 259 and DAU 246), the groundwater quality objective is an annual increase in electrical conductance (EC) of 1 micromho per centimeter (µmhos/cm).

For MUN, the Basin Plan specifies that "water designated MUN shall not contain concentrations of chemical constituents in excess of maximum contaminant levels (MCLs, Section 64431 through 64449, Title 22, California Code of Regulations)." For purposes of this evaluation, we compared groundwater below the Districts to the MCLs (Table 1).

Table 1
Maximum Contaminant Levels for Municipal Water Supply

Constituent	Primary/Secondary	Maximum Contaminant Level
Electrical Conductance	Secondary MCL	900 umhos/cm – Recommended 1,600 umhos/cm – Upper 2,200 umhos/cm – Short-Term
Total Dissolved Solids	Secondary MCL	500 mg/L – Recommended 1,000 mg/L – Upper 1,500 mg/L – Short-Term
Arsenic	Primary MCL	10 µg/L

Upper Maximum Contaminant Level (MCL) is acceptable if it is neither reasonable nor feasible to provide Recommended MCL water. Short -Term MCL is only acceptable on a temporary basis pending development of Recommended MCL water. µmhos/cm = micromho per centimeter, mg/L = milligrams per liter, and µg/L = micrograms per liter.

We assume that groundwater that exceeds an EC of 2,200 µmhos/cm, a TDS concentration of 1,500 mg/L, or an arsenic concentration of 10 micrograms per liter (µg/L) is not currently suitable as a source for MUN and would not be suitable for MUN in the future without expensive treatment to remove salts and/or arsenic.

The Basin Plan does not specify constituent concentrations for protection of AGR. For purposes of this evaluation, we compared groundwater below the Districts to the water quality guidelines published in *Water Quality for Agriculture* (Table 2, NATO, 1994).

Table 2
Water Quality Criteria for Agricultural Water Supply

Constituent	Irrigation Problem	Restriction on Use
Electrical Conductance	Salinity	<700 umhos/cm – None >3,000 umhos/cm – Severe
Total Dissolved Solids	Salinity	<450 mg/L – None >2,000 mg/L – Severe
Boron	Crop Sensitivity	<0.7 mg/L – None >3 mg/L – Severe
Sodium Adsorption Ratio	Infiltration	(severity varies with EC)

Based on Table 2, we will assume that groundwater exceeding an EC of 3,000 µmhos/cm, a TDS concentration of 2,000 mg/L or a boron concentration of 3 mg/L is not currently suitable for use as AGR and would not be suitable in the future without substantial dilution with fresh water. Sodium adsorption ratio (SAR) is used in conjunction with EC to evaluate irrigation water for infiltration problems; elevated salinity offsets the adverse soil infiltration effects of elevated SAR. SAR values as high as 40 are not typically a severe problem, unless EC is less than 2,900 µmhos/cm. Groundwater below the Districts has ECs ranging from 639 to 68,300 µmhos/cm and SAR should not result in an infiltration problem, except for the lower EC ground waters (less than 2,900 µmhos/cm).

The Basin Plan does not specify constituent concentrations for protection for IND, but indicates that "Uses of water for industrial activities do not depend primarily on water quality..."
For purposes of this evaluation, we assume that water quality criteria for MUN and/or AGR should normally be appropriate for IND.

California Department of Water Resources

Perched groundwater quality is characterized by the DWR using EC in µmhos/cm. In the BWSD, LHWD, and DRWD, the perched water EC ranges from 2,000 to greater than 20,000 µmhos/cm (Figure 8). Compared to the Secondary Drinking Water Standard for EC (900 µmhos/cm Recommended and 2,200 µmhos/cm for Short-term Use, Section 64449, Title 22, California Code of Regulations), the quality of perched groundwater is not suitable as a drinking water source. (Generally, TDS in mg/L is approximately 0.7 of EC in µmhos/cm.)

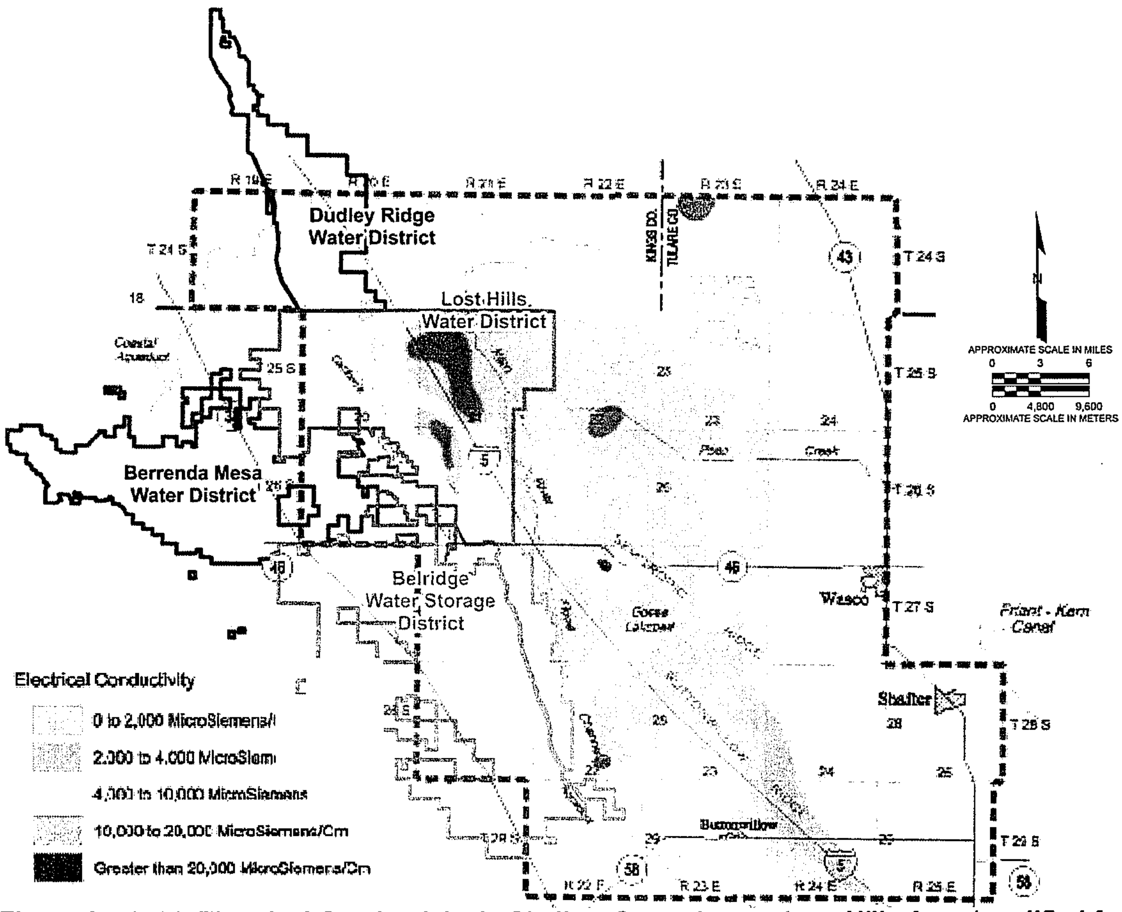


Figure 8 – 2001, Electrical Conductivity in Shallow Groundwater, Lost Hills Area (modified from DWR, 2001)

In 1993, the DWR published the results of a 1991 study of shallow groundwater in the vicinity of eastern part BWSD (DWR, 1993). Initially, DWR installed 88 shallow piezometers (20 feet deep) and 15 deeper piezometers (up to 55 feet deep) in the eastern part of BWSD and the nearby Buena Vista Water Storage District (BVWSD). In 1992, the DWR collected depth-to-water measurements and groundwater samples from the 55 piezometers. DWR found that the depth to shallow water below BWSD ranged from 5 to 10 feet on the eastern edge of BWSD to about 20 feet below the California Aqueduct. DWR indicated that groundwater generally flowed from west to east and groundwater EC varied from about 3,000 µmhos/cm along the eastern edge of BWSD to more than 18,000 µmhos/cm under the California Aqueduct (Figure 9).

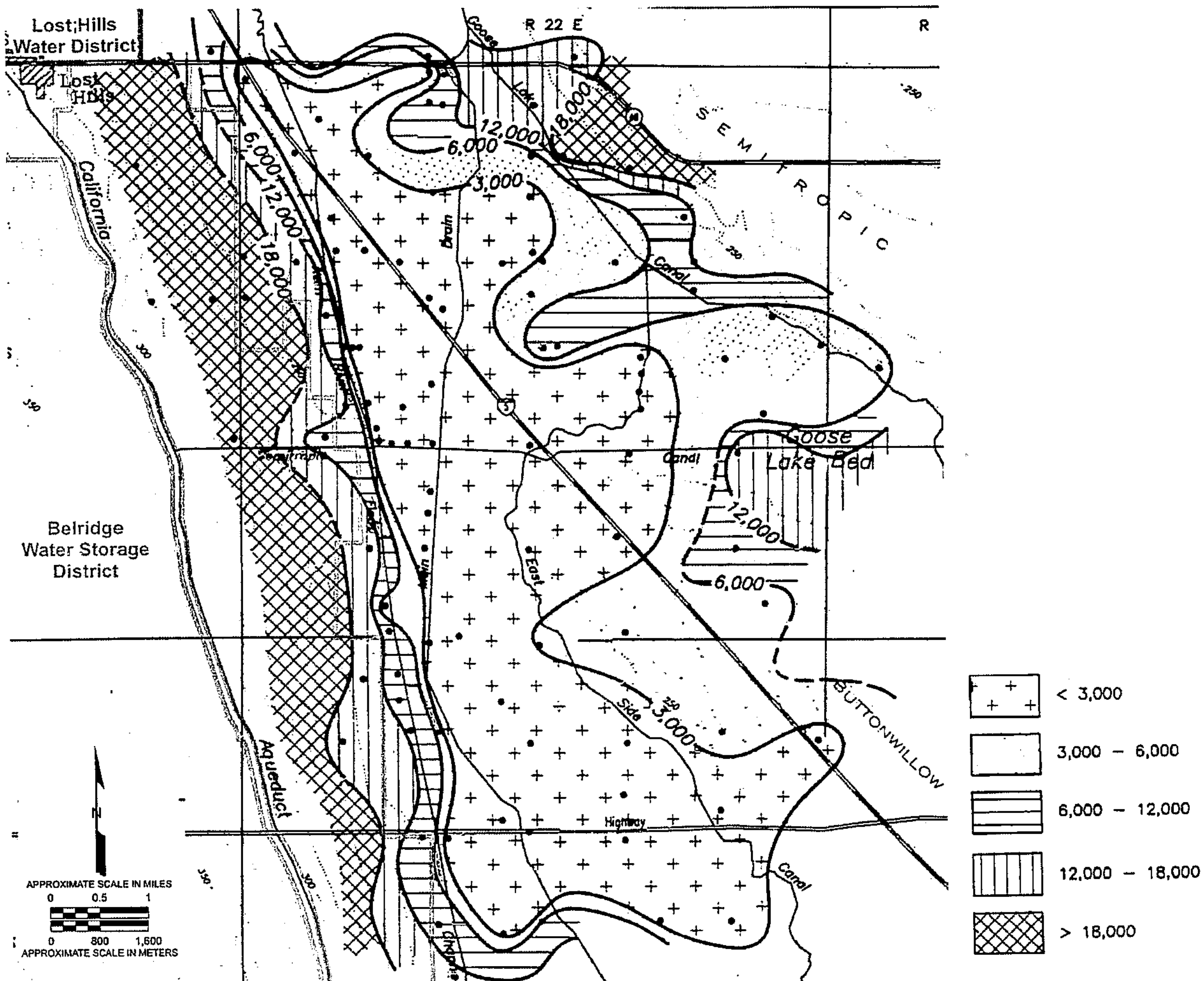


Figure 9 – Electrical Conductivity in Groundwater Below BWSD and BVWSD (modified from DWR, 1993)

DWR also arranged for analysis of 55 groundwater samples for selected inorganic chemical constituents including EC, TDS, and arsenic. Concentration ranges for samples collected below BWSD are summarized in Table 3.

Table 3
Range of Shallow Groundwater Quality, BWSD, 1992

Location	**EC (µmhos/cm)**	**TDS (mg/L)**	**Arsenic (µg/L)**
DWR Piezometers	639 – 68,300	365 – 61,500	0 – 336
Upper MUN	*2,200*	*1,500*	*10*
Upper AGR	*3,000*	*2,000*	--

These data show that groundwater below BWSD varies dramatically in areal distribution of mineral concentrations. Although isolated areas below the eastern part of BWSD may provide fair mineral quality shallow groundwater, much of the shallow groundwater below BWSD exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L) and the Primary MCL for arsenic (10 µg/L). Based on these data, shallow groundwater below much of BWSD is not suitable as a reliable source of MUN, without expensive treatment to remove salts and arsenic. These data also show that much of the shallow groundwater below BWSD exceeded recommended agricultural water quality criteria for EC (3,000 µmhos/cm) and TDS (2,000 mg/L). Based on these data, groundwater below most of BWSD is not suitable as a reliable source for AGR, without substantial dilution with fresh water.

KERN COUNTY WATER AGENCY

The KCWA characterized the quality of unconfined groundwater in the general area of the BWSD and LHWD using TDS (in mg/L) from historic data (Figure 10) (KCWA, 2005). Unconfined groundwater below the BWSD and LHWD ranged from 1,500 to greater than 5,000 mg/L TDS. Compared to the Secondary Drinking Water Standard for TDS (500 mg/L Recommended and 1,500 mg/L for Short-Term Use, Section 64449, Title 22, California Code of Regulations), the perched groundwater of these concentrations is not suitable as a drinking water source without expensive treatment to remove salts.

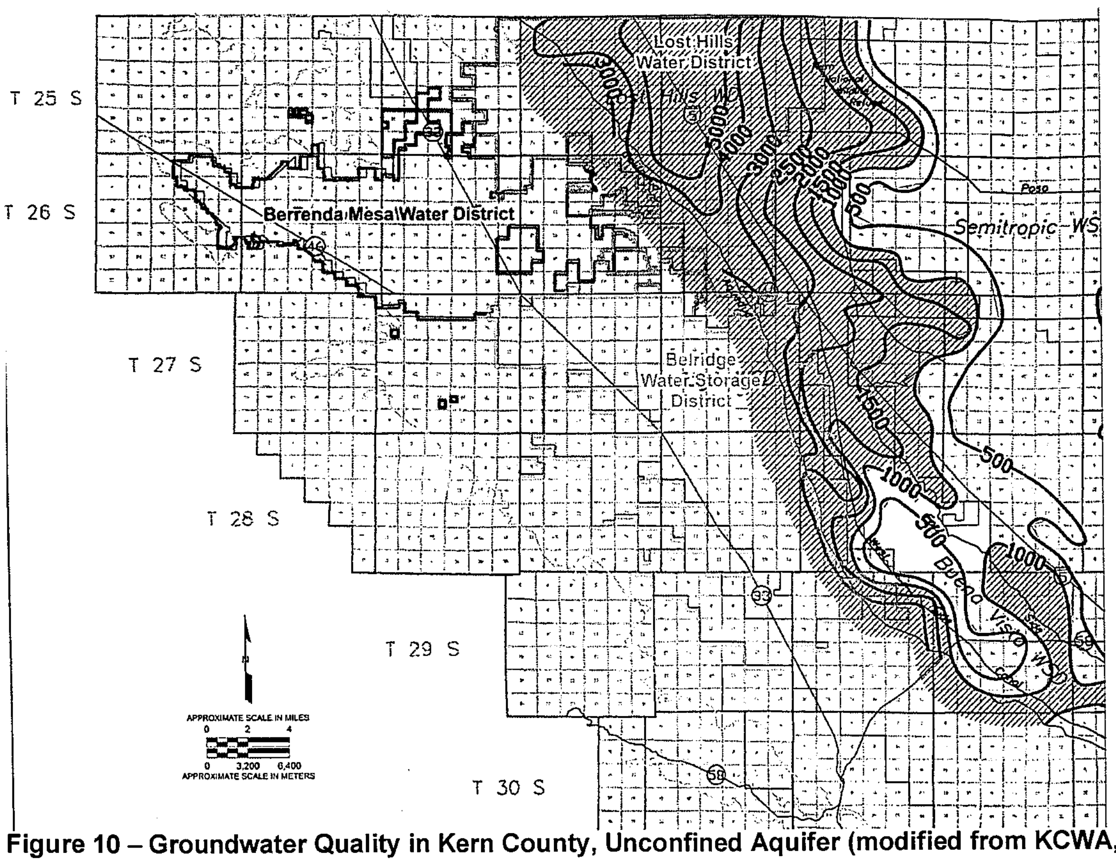


Figure 10 – Groundwater Quality in Kern County, Unconfined Aquifer (modified from KCWA, 2005)

The KCWA also characterized the quality of confined groundwater in the BWSD and LHWD using TDS in mg/L from historic data (Figure 11). Confined groundwater below the BWSD and LHWD ranged from 500 to greater than 4,000 mg/L TDS. Compared to the Secondary Drinking Water Standard for TDS (500 mg/L Recommended to 1,500 mg/L for Short-Term Use, Section 64449, Title 22, California Code of Regulations), the quality of confined groundwater is unlikely suitable as a drinking water source.

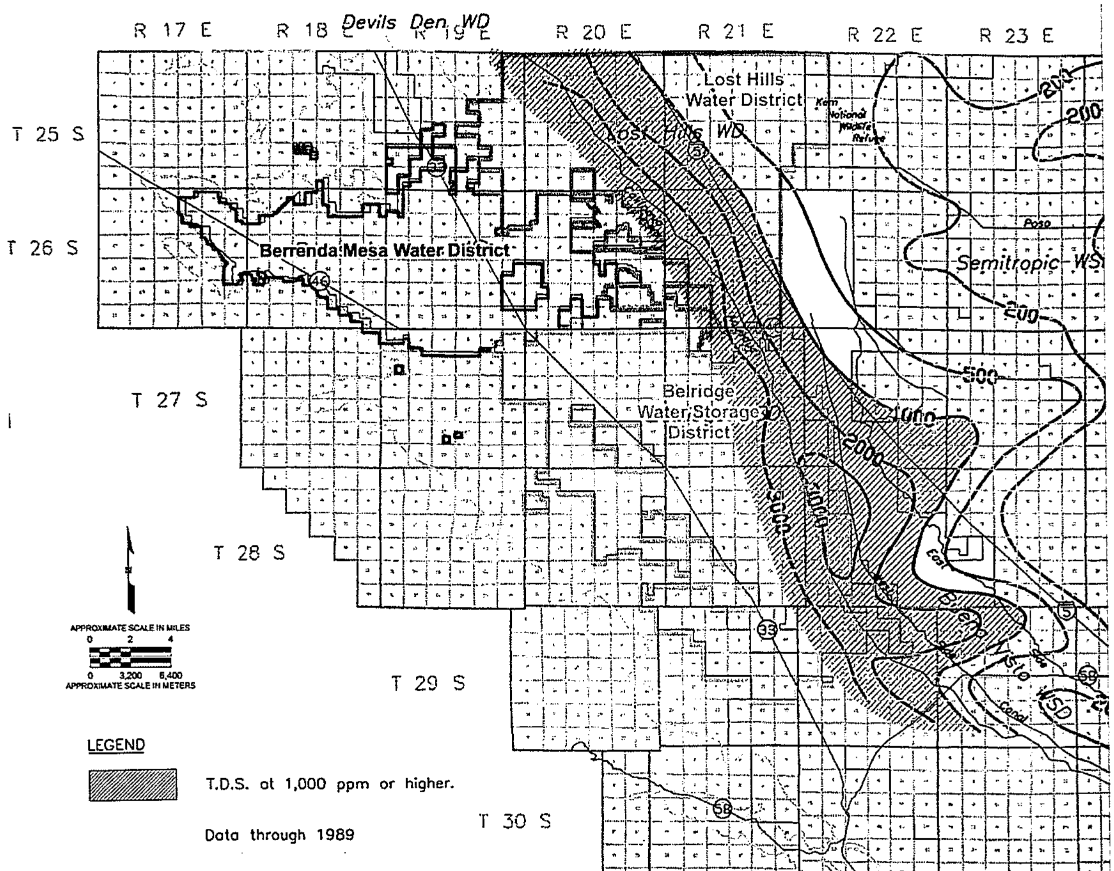


Figure 11 – Groundwater Quality, Confined Aquifer (modified from KCWA, 2005)

UNITED STATES GEOLOGICAL SURVEY

In 1989, the USGS conducted a study of groundwater quality within the Tulare Lake Basin (USGS, 1992). The study involved collection of water samples from 117 shallow wells and analysis of the samples for minerals and metals. The study report summarized TDS concentrations in shallow groundwater as shown on Figure 12.

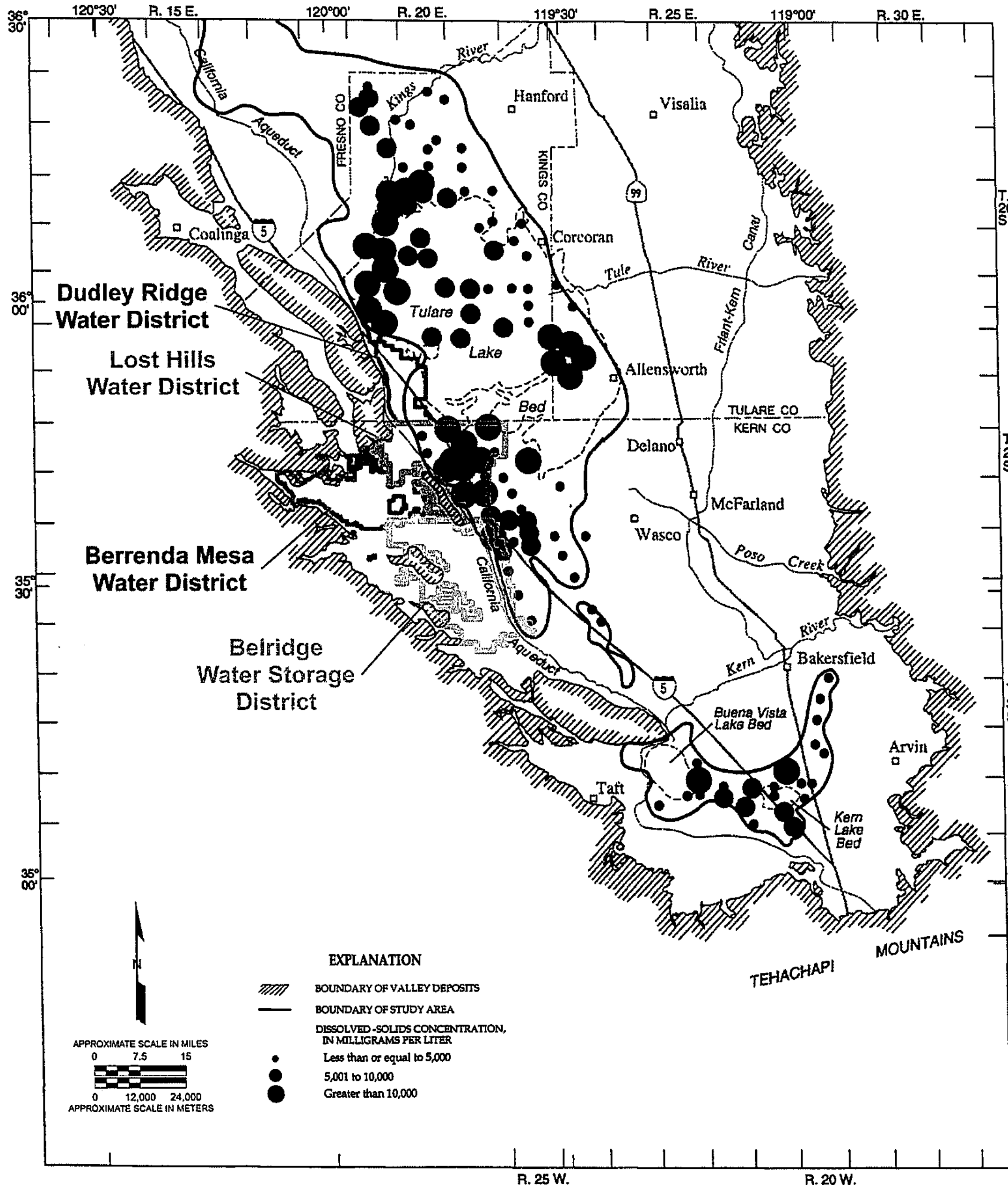


Figure 12 – Distribution of TDS in Shallow Groundwater (modified from USGS, 1992)

Figure 12 shows that TDS in groundwater within the BWSD, DRWD, and LHWD varies dramatically from less than 5,000 mg/L to greater than 10,000 mg/L. When compared to the secondary MCL of 500 to 1,500 mg/L, shallow groundwater within the BWSD, LHWD, and DRWD is not suitable for MUN, without expensive treatment for removal of salts. This report also identified reported arsenic concentrations in shallow groundwater that exceeded the corresponding MCL within the BWSD, DRWD, and LHWD.

In an earlier study of groundwater in the area (USGS, 1959), wells in BMWD and DRWD were sampled by USGS for analysis of salts. Between 1953 and 1955, the USGS sampled wells within BMWD (Township 26 and Ranges 16, 17, and 8) for general mineral analyses and generated the map summary shown on Figure 13.

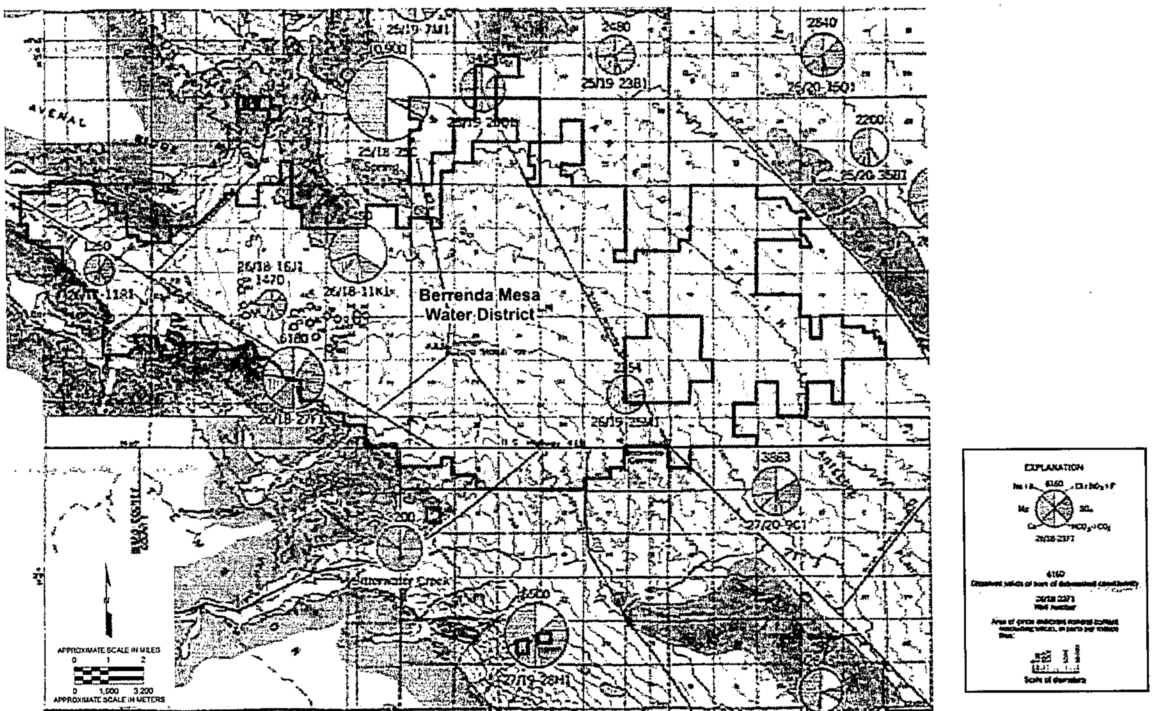


Figure 13 – Chemical Quality of Typical Groundwater in Berrenda Mesa Water District (modified from USGS, 1959)

The TDS of groundwater in BMWD ranged from 1,250 to 6,180 mg/L compared to the MCL of 500 to 1,500 mg/L, which indicates that the groundwater was not suitable for MUN, without expensive treatment to remove salts. TDS and boron (ranging from 0.3 to 11 mg/L) typically exceeded the recommended water quality criteria for agriculture (NATO, 1985) for TDS (2,000 mg/L) and boron (3 mg/L), which indicates that groundwater in this area was not suitable for AGR without substantial blending with SWP water.

Between 1953 and 1955, the USGS sampled wells in Township 22, Range 19 near Kettleman City and in Township 24, Range 19 in the southwest part of DRWD for general mineral analyses and generated the summary shown on Figure 14.

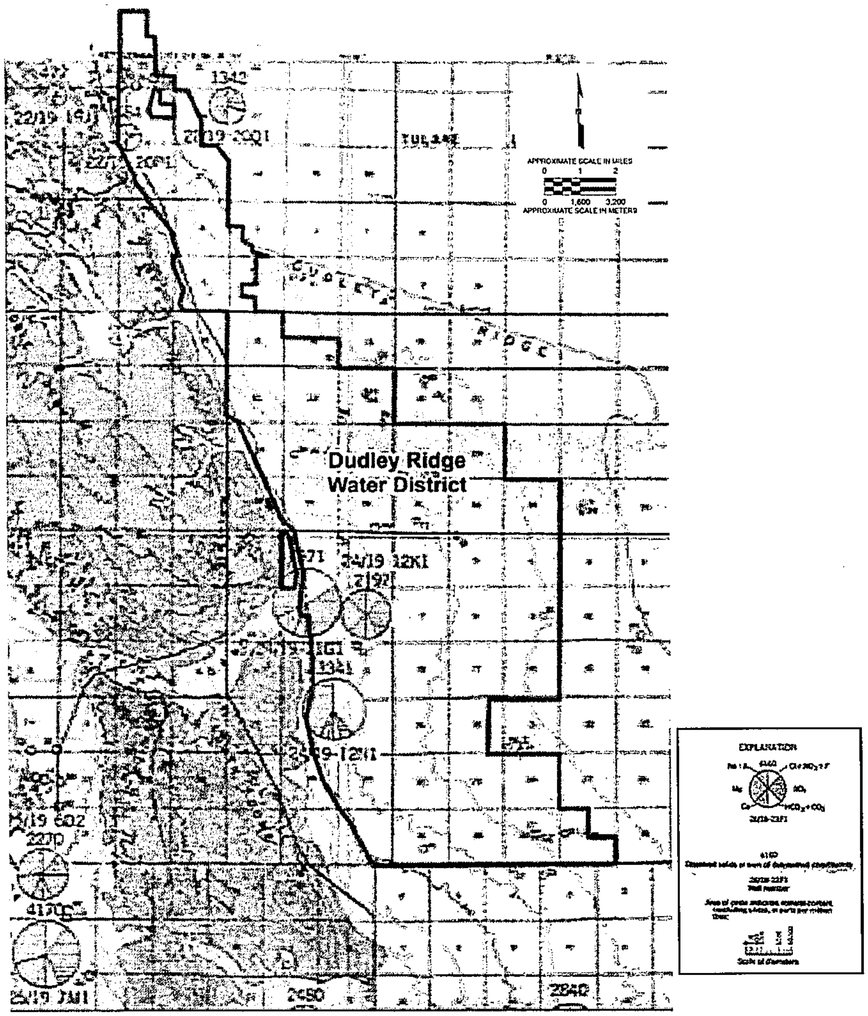


Figure 14 – Chemical Quality of Typical Groundwater for Dudley Ridge Water District (modified from USGS, 1959)

The TDS of groundwater in DRWD near Kettleman City ranged from 584 to 1,342 mg/L compared to the MCL of 500 to 1,500 mg/L, which indicates that the groundwater is marginally suitable for MUN. However, TDS in southwest DRWD ranged from 2,197 to 4,971 mg/L, which indicates that the groundwater was not suitable for MUN, without expensive treatment to remove salts. TDS and boron in southwest DRWD (ranging from 0.9 to 4.9 mg/L) typically exceeded the recommended water quality criteria agriculture (NATO, 1985) for TDS (2,000 mg/L) and boron (3 mg/L), which indicates that groundwater in this area was not suitable for AGR without substantial blending with SWP water.

In 1990, the USGS conducted some groundwater assessment work in the Tulare Lake Basin at the Refuge near LHWD. The assessment work involved installation of cluster wells at one location to assess the vertical differences in water quality, particularly for dissolved metals. The cluster consisted of wells completed to approximately 20, 50, 100, and 200 feet below ground surface and the wells were sampled in August 1990. Water samples from the well cluster near LHWD (designated 1N) were collected at 15, 57, 95, and 194 feet below ground surface, respectively. Table 4 summarizes the results for constituents the USGS analyzed from samples collected at well cluster 1N.

Table 4
Groundwater Quality with Depth N1 Well Cluster, Northeastern LHWD

Well	EC (µmhos/cm)	TDS (mg/L)	Arsenic (µg/L)	Boron (mg/L)	SAR (unitless)
1N-15'	1,750	1,270	6	0.87	6
1N-57'	12,000	9,280	16	9.4	29
1N-95'	6,250	4,260	10	2.1	13
1N-194'	4,540	2,620	8	1.3	10
Upper MUN	*2,200*	*1,500*	*10*	--	--
Upper AGR	*3,000*	*2,000*	--	*3*	*(varies w/EC)*

SAR calculated based on concentrations of bicarbonate, calcium, magnesium, and sodium.

The above data show that groundwater in the vicinity of the Refuge (northeastern LHWD) varies in quality with depth. The better quality shallow groundwater at 15 feet below ground surface is likely associated with imported SWP water used to maintain the wetlands that subsequently recharged from the wetlands to the shallow aquifer within the Refuge. These data show that groundwater below 20 feet in depth exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L) and the Primary MCL for arsenic (10 µg/L). Groundwater in this area is not suitable as a source of MUN without expensive treatment to remove salts and arsenic. These data also show that groundwater below 20 feet in depth exceeded recommended water quality criteria for agriculture (NATO, 1995) for EC (3,000 µmhos/cm), TDS (2,000 mg/L) and boron (3 mg/L). However, SAR would not appear to represent an infiltration problem because the average EC is greater than 2,900 µmhos. Groundwater in this area is not suitable for AGR without substantial dilution with SWP water. Blending groundwater with higher quality irrigation water would need to account for the effects of the elevated SAR in groundwater.

OTHER GROUNDWATER STUDIES

In 1976, Bookman-Edmonston Engineering, Inc. (BEE), evaluated groundwater conditions in BMWD (BEE, 1976). BMWD asked BEE to evaluate the feasibility of blending poor quality groundwater from the district with SWP water to provide an additional source of irrigation water supply. BEE reviewed the readily available groundwater information and found:

> "Mineral analyses of ground water are available for two wells, both of which are reported to be about 360 feet deep. Well 26/19-12L1 produced sodium sulfate water with a TDS concentration of 3,660 mg/L, a boron content of 2.7 mg/L and a chloride ion concentration of 629 mg/L. Water from well 26/19-25M1 was also sodium sulfate in character and contained 2,354 mg/L of TDS, 1.2 mg/L of boron and 505 mg/L of chloride. The total dissolved solids content is estimated to be about 3,000 milligrams per liter, which renders the water marginal to unsuitable for irrigation of most crops."

Based on this information, BEE recommended installation and testing of a prototype groundwater extraction well (26/19-29A), which was completed in 1977 (BEE, 1977). BEE installed a 14-inch diameter well with perforations between 650 and 1,160 feet in depth. BEE pump tested the well and found:

> "...on the basis of observed data, the well is capable of producing at a short-term rate of not more than 450 gallons per minute. It is probable that prolonged pumping will cause a lowering of the water level and a coincident decline in yield."

A water sample from well 26/19-29A was collected by BEE in May 1977 and analyzed for inorganic constituents (see Table 5).

Table 5
Groundwater Quality, BMWD

Well	**EC (µmhos/cm)**	**TDS (mg/L)**	**Boron (mg/L)**	**SAR (unitless)**
26/19-29A-650/1160'	4,000	2,583	1.8	16.7
Upper MUN	*2,200*	*1,500*	--	--
Upper AGR	*3,000*	*2,000*	*3*	*(varies w/EC)*

SAR calculated based on concentrations of bicarbonate, calcium, magnesium and sodium.

These data show that groundwater in BMWD exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L). Groundwater in this area is not suitable as a source of MUN without expensive treatment to remove salts. These data also show that groundwater in BMWD exceeded recommended agricultural water quality criteria for EC (3,000 µmhos/cm) and TDS (2,000 mg/L). However, SAR would not appear to represent an infiltration problem because the average EC is greater than 2,900 µmhos/cm. Groundwater in this area is not suitable for AGR without substantial blending with fresh water and may not be hydraulically sustainable. Blending groundwater with higher quality irrigation water would need to account for the effects of the elevated SAR in groundwater.

In 2006, AMEC conducted a vertical characterization of groundwater quality at the proposed Westlake Farms Proposed Biosolids Composting Project, which is immediately adjacent the eastern part of DRWD near Utica Avenue. Water samples were collected from ten groundwater monitoring wells. Two of the wells are representative of groundwater quality from 11 to 26 feet (MW1) and from 80 to 100 feet (MW101). Data from these two wells are summarized in Table 6.

Table 6
Groundwater Quality with Depth, East of DRWD

Well	**EC (µmhos/cm)**	**TDS (mg/L)**	**Arsenic (µg/L)**	**Boron (mg/L)**	**SAR (unitless)**
MW1-11/26'	23,000	20,000	54	8.5	28
MW101-80/100'	16,000	16,000	38	7.4	22
Upper MUN	*2,200*	*1,500*	*10*	--	--
Upper AGR	*3,000*	*2,000*	--	*3*	*(varies w/EC)*

SAR calculated based on concentrations of bicarbonate, calcium, magnesium and sodium.

Similar to the data summarized above, groundwater adjacent the eastern part of DRWD exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L) and the Primary MCL for arsenic (10 µg/L). Groundwater in this area is not suitable as a source of MUN without expensive treatment to remove salts and arsenic. These data also show that groundwater adjacent the eastern part of DRWD exceeded recommended agricultural water quality criteria for EC (3,000 µmhos/cm), TDS (2,000 mg/L) and boron (3 mg/L). However, SAR would not appear to represent an infiltration problem because the EC is greater than 2,900 µmhos/cm. Groundwater in this area is not suitable for AGR without substantial blending with fresh water. Blending groundwater with higher quality irrigation water would need to account for the effects of the elevated SAR in groundwater.

MUNICIPAL WATER SUPPLY

In 2012, the SWRCB conducted a study of communities that rely on contaminated groundwater (SWRCB, 2012b). Only two community water systems with groundwater supply were identified in the immediate vicinity of the Districts; LHUD and Kettleman City Community Services District (Figure 17).

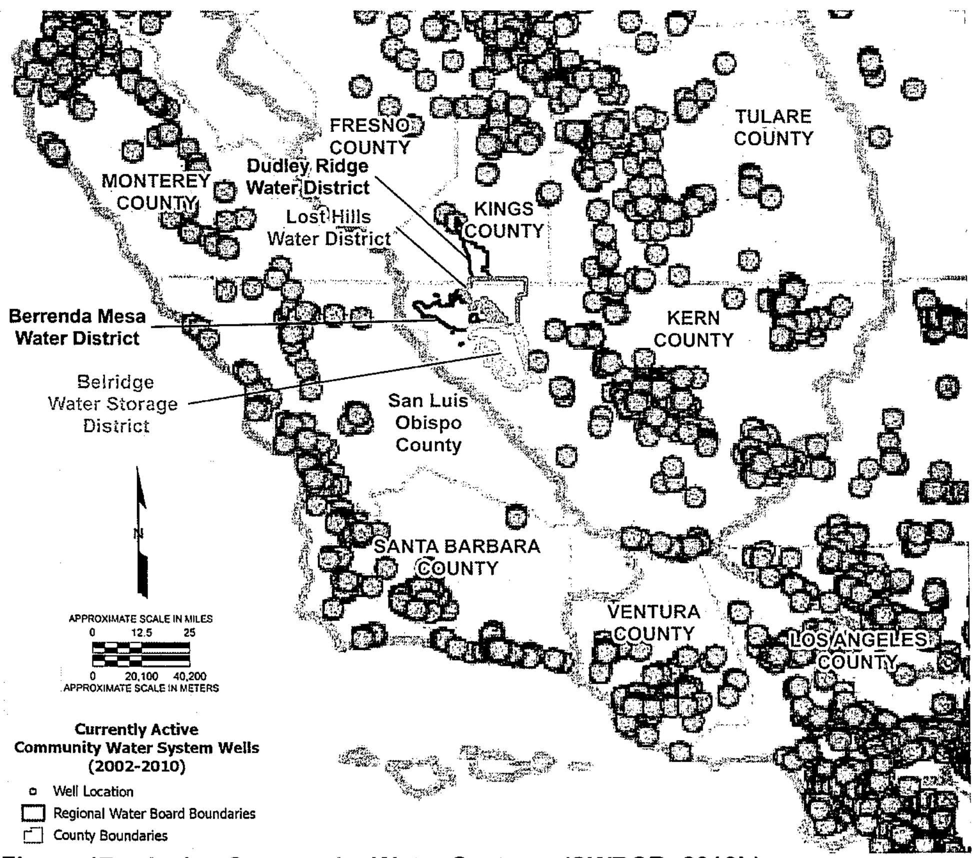


Figure 17 – Active Community Water Systems (SWRCB, 2012b)

Both communities are immediately adjacent to the Districts and listed as having contaminated wells. Lost Hills is situated between BWSD and LHWD, and Kettleman City is located just north of DRWD (Figure 18). LHUD water system was listed for elevated arsenic concentrations ranging from 12 to 51 µg/L. Kettleman City water system was listed for arsenic concentrations ranging from 12 to 160 µg/L. The well water from both communities exceeds the primary MCL of 10 µg/L of arsenic. The community of Lost Hills imports groundwater from wells 13 miles east of any of the Districts. The Kettleman City Community Services District (KCCSD) currently uses water from two local wells that are just north of DRWD. In either case, the arsenic is likely a naturally occurring condition, unrelated to agricultural irrigation. KCCSD is currently working with the California Department of Public Health to develop a treated municipal water supply from the California Aqueduct to replace groundwater (CDPH, 2012).

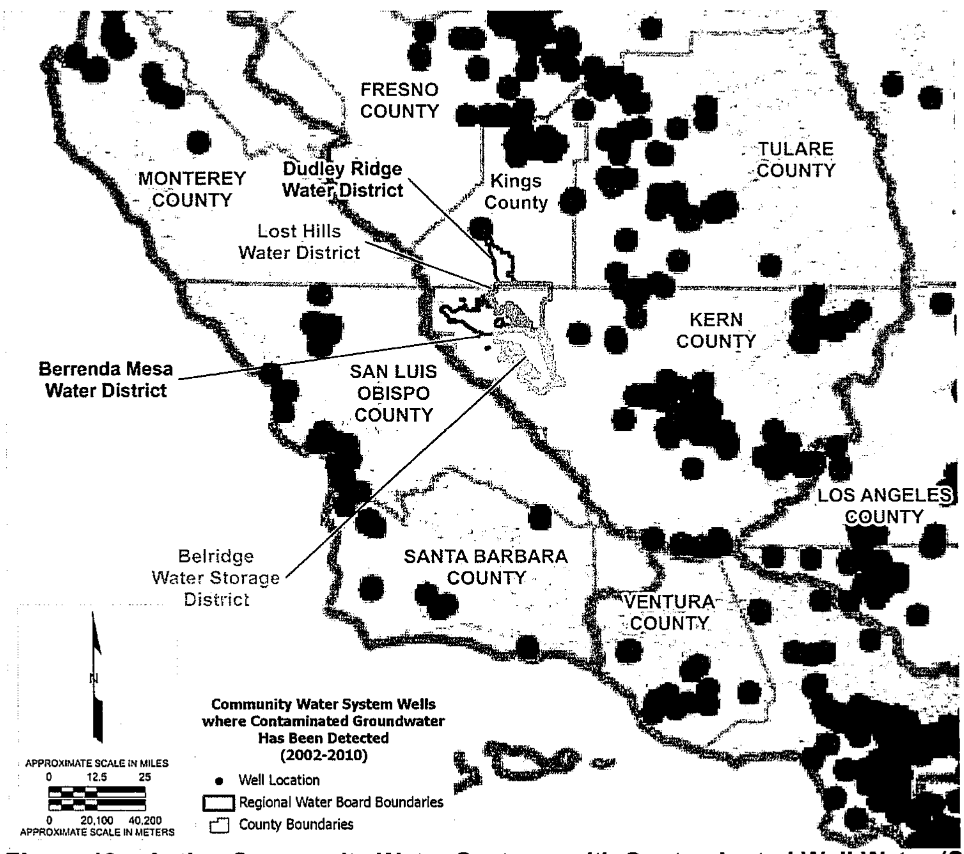


Figure 18 – Active Community Water Systems with Contaminated Well Water (SWRCB, 2012b)

AGRICULTURAL WATER SUPPLY

As described previously, the principle irrigation water supply for the Districts is the SWP from deliveries from the California Aqueduct. Alternative water supplies include groundwater banked in storage near Bakersfield and purchase of water on the open market. Groundwater is not typically used for irrigation within the Districts due to the presence of elevated salts and boron concentrations. According to the Districts, groundwater has occasionally been diluted with SWP water for irrigation, but this has apparently occurred rarely.

Crop types irrigated within the Districts have changed dramatically over the past two decades. More permanent crops have been developed in conjunction with more efficient irrigation systems. For example, LHWD indicates that cotton and other row crops (sprinkler irrigation) that were predominate in 1990 (64 percent of irrigated acreage within LHWD) have been almost completely replaced with orchards and vines (drip or fan jet irrigation) as of 2012 (99 percent of acreage in LHWD).

According to Encyclopedia of Water Science, sprinkler irrigation varies from 60 to 85 percent efficient, while drip and fan jet systems typically average 85 percent irrigation efficiency (Howell, 2003). Based on the dramatic change in cropping pattern in LHWD, development of more efficient irrigation systems, and implementation of irrigation management practices by farmers in LHWD, very little irrigation water would be expected to percolate below the root zone of crops. Irrigation efficiency and management practices have contributed to a decline in the amount of water collected in LHWD tile drains. In 1990, LHWD tile drains produced 3,088 acre feet of water that was discharged to the LHWD evaporation disposal basins (PPEG, 2012). The water volume generated from the LHWD tile drains in 2011 was only 94 acre-feet. This dramatic decline of almost 3,000 acre-feet in the volume of tile drainage is a result, at least in part, of the change to permanent crops, more efficient irrigation systems, and irrigation management practices within the district.

Similar changes to permanent crops and efficient irrigation systems have occurred in BWSD, BMWD, and DRWD. While the changes may not be as dramatic as in LHWD, the permanent crops and efficient drip/fanjet irrigation systems have also been implemented in the other Districts, to some degree. In addition, 20 percent of the formerly irrigated acreage in BMWD has returned to dry land farming, which uses no irrigation water. In the other Districts, we would expect to see a similar decline in irrigation water percolating below crop root zones, commensurate with the implementation of efficient irrigation systems, management practices, and the return to dry land farming.

PROCESS WATER SUPPLY

Industrial facilities within the Districts that require potable water (food processing plants) treat water from the California Aqueduct (RWQCB, 1996 and 1999). Groundwater within the oil fields is used for water and steam flood enhanced recovery operations and is treated, if necessary, to achieve the required water quality. Groundwater is also used for non-potable purposes at biosolids composting facilities. No other PRO uses are known within the Districts.

SUMMARY

Groundwater within the Districts is generally of poor mineral quality (generally greater than 2,000 mg/L TDS) and contains other mineral constituents (arsenic) that have prevented its use for drinking water. The quality of groundwater varies dramatically in its horizontal and vertical distribution. As such, groundwater within the Districts, except in the far northern part of DRWD (Kettleman City), is not used for municipal water supply. Imported water is used for drinking water within most of the Districts' area due to the poor mineral quality of groundwater encountered beneath them.

The poor mineral quality of groundwater (EC, TDS, and boron) has also prevented its use for agricultural irrigation. Based on the poor quality of groundwater within the Districts, they are provided irrigation water from the SWP from the California Aqueduct. According to the Districts, farmers have occasionally blended groundwater with imported SWP water to make up irrigation water. However, significant dilution is required to meet irrigation water quality objectives, rendering this practice uneconomical.

In the RWQCB's Tulare Lake Basin Plan, groundwater within the Districts is designated as having the beneficial use of MUN, in part based on the SWRCB's *Sources of Drinking Water Policy* (SWRCB, 1988). Based on the above information, groundwater within the Districts:

- range from 1,000 mg/L TDS to more than 10,000 mg/L TDS and, as such, is not used for MUN and is not anticipated to be used for MUN, except in northern end of DRWD (Kettleman City);
- is administratively exempted from MUN for the purpose of underground injection of fluids into exempted aquifers associated with the production of oil and gas in some areas of each District; and
- contains naturally occurring salts and petroleum and, in some areas, is impacted by oil field operations, such that it cannot be reasonably treated for MUN.

Based on the above, the protection of MUN uses within the Districts would not appear warranted, based on the exemptions of the Sources of Drinking Water Policy (RWQCB, 2004). The burden to farmers within the Districts, including costs, of protection for MUN would not appear to bear a reasonable relationship to the benefit to the groundwater resource that might be obtained from the proposed ILRP program. The Districts have asked AMEC to convey their request for the RWQCB to exempt farmers within the Districts from groundwater regulation under the ILRP.

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